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Richard P. Berg, Esq.
c/o LADAS & PARRY
Suite 2100
5670 Wilshire Boulevard
Los Angeles, CA 90036-5679

EXAMINER
SONG, MATTHEW J

ART UNIT	PAPER NUMBER
1765	9

DATE MAILED: 06/23/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/851,839	SHI, BINQIANG	
	Examiner	Art Unit	
	Matthew J Song	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *15 April 2003* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-27 and 29-40* is/are pending in the application.

4a) Of the above claim(s) *34-38* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-27, 29-33 and 39-40* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-11, 25-27, 29-31 and 39-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pessa et al (US 4,876,218) in view of Hayakawa et al (US 4,824,518).

Pessa et al discloses a method of a GaAs film on the surface of a Si or GaAs substrate (abstract), where an effusion cell **3** contains a Ga elementary componet of a GaAs compound, e.g. Ga atoms, and an effusion cell **4** contains the As elementary component, e.g. as As_4 molecules. Pessa et al also teaches heating the substrate to a first growing temperature of 100°C to 500°C, heating the Ga effusion cell **3** to 800°C and heating the As effusion cell **4** to 300°C. Pessa et al also teaches opening a shutter **6** in front of As cell and a vapor beam of As_4 molecules is allowed to act on the surface of the substrate for a period of time which is required for the formation of one atom layer, this reads on applicant's first layer of material over the substrate, and excess arsenic is removed through re-evaporation and the growing surface by one atom layer only. Pessa et al also teaches shutter **6** is closed and a shutter **5** is opened and a vapor beam containging Ga atoms is allowed to act on the growing surface until a number of Ga atoms corresponding to a single atom layer reaches the growing surface, this reads on applicant's second layer of second material over the first layer (col 3, ln 1-60). The As layer and the Ga

layer of atoms forms a buffer layer, where the buffer layer cause reduction in lattice strain by creating mismatch dislocations which have a relatively low of action and which as a result lead to the reduction of treading dislocations (col 2, ln 25-43 and col 3, ln 61-64), this reads on applicant's first layer substantially accommodates strain accumulated between the first crystal and the second crystal during epitaxial growth, thereby preventing strain relaxation and formation of dislocation defects. Pessa et al also teaches after the growth of the buffer layer, the substrate is heated to a second growth temperature ranging from 500-700°C and both the Ga and As beams act simultaneously on the growing surface until the desired GaAs film thickness is obtained by Molecular Beam Epitaxy (col 3, ln 65 to col 4, ln 10), this GaAs layer reads on applicant's second crystal. Also the substrate of Si or GaAs inherently has a lattice constant and the GaAs epitaxial film inherently has a lattice constant

Pessa et al does not teach cleansing a surface of the first crystal by thermal desorption.

In a method of production semiconductor devices, Hayakawa et al teaches a GaAs substrate is heated to about 600°C during a radiation treatment by an As_4 molecular beam with about 10^{-6} to 10^{-5} torr and is allowed to stand at about 600°C for about 10 minutes, and after which the temperture of the GaAs substrate is lowered to 200°C or less during a radiation treatment by the As_4 molecular, thereby achieving complete removal of an oxidized film formed on the GaAs substrate and obtaining a GaAs substrate with a clean surface (col 4, ln 5-67), this reads on applicant's cleansing by thermal desorption. Hayakawa et al also teaches removing oxidized film of GaAs with a As molecular beam with a high pressure of 10^{-4} to 10^{-5} torr (col 1, ln 55-67). Hayakawa et al also teaches growing high quality GaAlInP epitaxial layers by MBE on a GaAs substrate (col 5, ln 1-30). It would have been obvious to a person of ordinary skill in

the art at the time of the invention to modify Pessa et al with Hayakawa et al to clean the surface of the substrate to remove oxide from the surface, which is detrimental to epitaxial growth.

Referring to claims 2-3, the combination of Pessa et al and Hayakawa et al teaches heating to 600°C and an As pressure of 10^{-5} to 10^{-4} torr (.013 to 0.0013 Pa). Overlapping ranges are held to be obvious (MPEP 2144.05)

Referring to claim 4-5 and 8-9, the combination of Pessa et al and Hayakawa et al teaches a GaAs substrate and an As_4 vapor.

Referring to claim 6, the combination of Pessa et al and Hayakawa et al teaches removing excess arsenic by re-evaporation, so the growing surface grows by only one atom layer at a time (col 3, ln 45-47), this reads on adjusting the thickness by varying a temperature of the first crystal. The combination of Pessa et al and Hayakawa et al is silent to the first vapor condenses on the surface of the first crystal. This is inherent to the combination of Pessa and Hayakawa et al because a layer of Arsenic is formed on a substrate held at a low temperature, 100°C, from arsenic vapor. The As vapor is at a temperature of 300°C and the substrate is at a temperature is a temperature of 100°C, hot vapors inherently condense on cool . This is a well-known concept in the art.

Referring to claim 7, the combination of Pessa et al and Hayakawa et al teaches depositing a first layer at 100°C to 500°C and raising the substrate temperature to a second growth temperature ranging from 500-700°C, this reads on applicant's first vapor is introduced at a temperature which is less than an optimal temperature for epitaxy.

Referring to claim 10 and 30, the combination of Pessa et al and Hayakawa et al teaches a monolayer, this reads on a few angstroms.

Referring to claim 11, the combination of Pessa et al and Hayakawa et al teaches a shutter **5**.

Referring to claim 25-26, the combination of Pessa et al and Hayakawa et al teaches the invention relates to a method for production of semiconductor devices and light emitting semiconductor devices ('518 col 1, ln 5-67), this reads on optoelectronic applications.

Referring to claim 27, the combination of Pessa et al and Hayakawa et al teaches a cleansing by thermal desorption, depositing an As monolayer, depositing a Ga monolayer and depositing a GaAs crystal over the Ga layer.

Referring to claim 29 and 39-40, the combination of Pessa et al, Hayakawa et al and Ogasawara teaches a substrate of GaAs, a first material of As, a second material of Ga and a crystal of GaAs.

Referring to claim 31, the combination of Pessa et al, Hayakawa et al and Ogasawara teaches a single atom layer of Ga, this reads on monolayer.

3. Claims 12-16 and 18-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pessa et al (US 4,876,218) in view of Hayakawa et al (US 4,824,518) as applied to claims 1-11 above, and further in view of Ogasawara (US 4,897,367).

The combination of Pessa et al and Hayakawa et al teaches all of the limitations of claim 12 including depositing a Ga layer on a As layer at a substrate temperature of 100-500°C and heating the substrate to a second growth temperature ranging from 500°C-700°C, this reads on annealing, as discussed previously in claim 6. The combination of Pessa et al and Hayakawa et al

does not teach annealing the second layer by raising the temperature of the first crystal under a pressure of the first vapor of about 0.008 Pa.

In a method of growing GaAs, note entire reference, Ogasawara teaches depositing a GaAs layer **2** on a silicon substrate **1**, where the GaAs layer is formed at a substrate temperature of 60°-90°C by irradiating an As beam and a Ga beam on the substrate. Ogasawara also teaches the tempertuere of the substrate **1** is increased to 200°C-400°C, while irradiating the substrate with an As beam to prevent out-diffusion of As from the GaAs layer **2** when heated (col 2, ln 10-67). Ogasawara also teaches a Ga beam is irradiated in an amount needed to form a GaAs monomolecure layer (for about 1 sec) It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Pessa et al and Hayakawa et al with Ogasawara by irradiating a GaAs layer with an As beam to prevent out-diffusion of As during a heating step.

Referring to claim 13, the combination of Pessa et al, Hayakawa et al and Ogasawara teaches introducing a Ga flux to form a Ga monolayer.

Referring to claim 14, the combination of Pessa et al, Hayakawa et al and Ogasawara teaches a Ga effusion cell **3** with a shutter **5** and opening the shutter until a number of Ga atoms corresponding to a single atom layer reaches the growing surface and closing the shutter after this time.

Referring to claim 15, the combination of Pessa et al, Hayakawa et al and Ogasawara teaches a GaAs first crystal, a As first material and a Ga second material.

Referring to claim 16, the combination of Pessa et al, Hayakawa et al and Ogasawara teaches a first crystal of GaAs and a first material of As_4 and a second material of Ga. The

combination of teaches the vapor has a temperature of 800°C. The combination of Pessa et al, Hayakawa et al and Ogasawara is silent to the pressure of the second vapor The sole difference between the prior art and the claimed limitations is the pressure and temperature of the vapor. The selection of reaction parameters such as temperature and concentration is obvious (In re Aller 105 USPQ 233, 255 (CCPA 1955)). Pressure is well known in the art to be a result effective variable.

Referring to claim 18, the combination of Pessa et al, Hayakawa et al and Ogasawara teaches a time duration of 1 sec.

Referring to claim 19, the combination of Pessa et al, Hayakawa et al and Ogasawara teaches opening the shutter for 1 second and is silent to the number per surface area of group III atoms form the monolayer is about 6.5e14 cm^{-2}. The selection of reaction parameters such as temperature and concentration is obvious (In re Aller 105 USPQ 233, 255 (CCPA 1955)). The Flux of a reactnt is well known in the art to be a result effective variable. Also the prior art show the amount of time the shutter is open results in more atoms reaching the surface.

Referring to claim 20, the combination of Pessa et al, Hayakawa et al and Ogasawara teaches a monolayer, this reads on a few anstroms to a few tens of angstroms.

Referring to claim 21, the combination of Pessa et al, Hayakawa et al and Ogasawara teaches introducing a Ga flux and an As flux at a temperture of 500-700°C for a molecular beam epitaxy growth of GaAs.

Referring to claim 22, the combination of Pessa et al, Hayakawa et al and Ogasawara teaches shutters **5** and **6**.

4. Claims 17 and 23-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pessa et al (US 4,876,218) in view of Hayakawa et al (US 4,824,518) and Ogasawara (US 4,897,367) as applied to claims 12-16 and 21-22 above, and further in view of Grunthaner et al (US 5,094,974).

The combination of Pessa et al, Hayakawa et al and Ogasawara teaches all of the limitations of claim 23, as discussed previously in claim 22, except the ratio of the group V flux to the group III flux is substantially in the range of about 1.5 to about 3.

In a method of growing group III-V films by control of MBE growth stoichiometry, Grunthaner et al teaches instantaneous flux ratios of In to As have been critical to the control of defect generation in the lattice mismatched epitaxy of InAs on GaAs (col 2, ln 25-40). Grunthaner et al also teaches a substrate temperature of 250-750°C during deposition of a InAs on a GaAs layer (col 4, ln 1-10). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Pessa et al, Hayakawa et al and Ogasawara with Grunthaner by optimizing the ratio of group V flux to the group-III flux substantially in the range of 1.5 to about 3 by conducting routine experimentation. The selection of reaction parameters such as temperature and concentration is obvious (In re Aller 105 USPQ 233, 255 (CCPA 1955)). The ratio of fluxes is a result effective variable as taught by Grunthaner et al.

Referring to claim 17, the combination of Pessa et al, Hayakawa et al and Ogasawara is silent to the combination of Ga,Al and In are in relative ratio substantially equal to the ratio of elements forming the second crystal. The selection of reaction parameters such as temperature and concentration is obvious (In re Aller 105 USPQ 233, 255 (CCPA 1955)). The ratio of fluxes is a result effective variable as taught by Grunthaner et al.

Referring to claim 24, the combination of Pessa et al, Hayakawa et al and Ogasawara does not teach a second crystal of InAs, $In_xGa_{1-x}As$, $In_xAl_{1-x}As$ or GaP. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Pessa et al, Hayakawa et al and Ogasawara with Grunthaner to form a InAs layer, which useful in Josephson devices ('974 col 5, ln 1-7).

5. Claims 32-33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pessa et al (US 4,876,218) in view of Hayakawa et al (US 4,824,518) and Ogasawara (US 4,897,367) and Grunthaner et al (US 5,094,974) as applied to claims 17 and 23 above, and further in view of Kubiak et al (US 4,330,360).

The combination of Pessa et al, Hayakawa et al, Ogasawara and Grunthaner et al teaches all of the limitations of claim 32, as discussed previously, including heating a substrate to 600°C and annealing under a pressure of As_4 vapor, which is equivalent to As_2, of 10^{-4} to 10^{-5} torr (.013 to .0013 Pa). ('518 col 4, ln 45-55 and col 1, ln 45-67). The combination of Pessa et al, Hayakawa et al, Ogasawara and Grunthaner et al also teaches growing one arsenic atom layer and removing excess arsenic through re-evaporation, where the evaporation temperature of As in on the order of 300°C. The combination of Pessa et al, Hayakawa et al, Ogasawara and Grunthaner et al also teaches it is impossible to lower the strength of the As molecular beam which has an extremely high pressure of 10^{-4} to 10^{-5} in a short time, therefore As used in the growth chamber is present during growth of compound semiconductors ('518 col 1, ln 45 to col 2, ln 5), this reads on applicant's subjecting the substrate to an As_2 vapor pressure of about 0.008 Pa for forming a monolayer of In atoms. The combination of Pessa et al, Hayakawa et al,

Ogasawara and Grunthaner et al also teaches annealing under an As_4 pressure and the buffer layer reduces dislocations between the substrate and the epitaxial layer, this reads on applicant's epitaxial growth does not introduce dislocation defects cause by lattice mismatch. The combination of Pessa et al, Hayakawa et al, Ogasawara and Grunthaner et al is silent to introducing In vapor at a temperature of about 790°C.

In an MBE process using group V elements, Kubiak et al teaches nominal effusion cell temperatures range from 900-1000°C for Ga and 800-840°C for In depending on the effusion cell to substrate distance and the group III beam intensities may be regulated by varying the effusion cell temperature (col 3, ln 40 to col 4, ln 15). It would have been obvious to a person of ordinary skill in the art at the time of the invention modify the combination of Pessa et al, Hayakawa et al, Ogasawara and Grunthaner et al with Kubiak et al by optimizing the effusion cell temperature by conducting routine experimentation of result effective variables. The selection of reaction parameters such as temperature and concentration is obvious (In re Aller 105 USPQ 233, 255 (CCPA 1955)).

Referring to claim 33, The combination of Pessa et al, Hayakawa et al, Ogasawara and Grunthaner et al and Kubiak et al does not teach a ratio of flux is maintained at 2.5. The selection of reaction parameters such as temperature and concentration is obvious (In re Aller 105 USPQ 233, 255 (CCPA 1955)).

Response to Arguments

6. Applicant's arguments filed 4/15/2003 have been fully considered but they are not persuasive.

Applicant's argument regarding claim 1 that the Pessa reference fails to teach the first layer substantially accommodates strain accumulated between the first crystal and the second crystal has been considered but has not been found persuasive. Applicants contend that the As layer of Pessa does not accommodates strain because the As layer **and** the Ga layer form a buffer layer, which reduces lattice strain. The As layer and the Ga layer both accommodate strain. It is noted that the buffer layer, which reduces lattice strain, is formed of an As layer **and** a Ga layer, however as instantly claimed the first layer does accommodate strain, therefore reads on applicant's invention.

Applicant's arguments regarding claim 32 have been considered but have not been found persuasive. Applicant's contend the Examiner is asserting that it would have been obvious to combine Pessa et al, Hayakawa et al, Ogasawara and Grunthaner et al with Smith or Cox, however, this is not the case. The Smith and Cox references are provided solely as a teaching of the inherent feature of condensing arsenic vapor and are not incorporated into the rejection.

Applicant's argument regarding claim 32 that it is unclear how the combination of references that teach it is impossible to lower the strength of the As molecular beam to perform the step of depositing a mono-layer of In atoms has been noted but has not been found persuasive. The deposition of the In mono-layer requires an As_2 vapor pressure of about 0.008 Pa, note instant claim 32, c1. This is the limitation, which is taught by the inability to lower the strength of the As molecular beam. The deposition of the In monolayer is taught by the Grunthaner et al reference, which teaches the deposition of In on a GaAs layer to establish an InAs stoichiometry, note col 3, ln 10-50 and col 4, ln 40-50.

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Smith et al (US 5,538,702) Smith et al teaches a condenser is held at 100°C to effect the condensation of arsenic and at such a temperature the arsenic will condense on the internal surface of the condenser (col 5, ln 1-10)

Cox (US 4,645,689) teaches a region having a temperature less than 200°C is sufficient for condensing arsenic (col 5, ln 14-20)

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J Song whose telephone number is 703-305-4953. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin L Utech can be reached on 703-308-3868. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

Matthew J Song
Examiner
Art Unit 1765

MJS
June 19, 2003

BENJAMIN L. UTECH
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700